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High Beam Assistant (FLA)

Model: E60, E61, E63 LCI, E64 LCI

Production: From 2008 Model Year

OBJECTIVES

After completion of this module you will be able to:

- Understand the operation of the FLA system
- Identify the components used in the FLA system
- Identify the operating parameters needed for the FLA activation/de-activation

Introduction

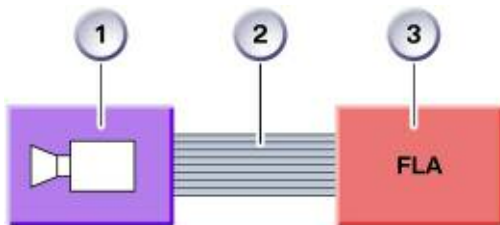
The high beam assistant (FLA) assists the driver in the use of the high beam headlight. The high beam assistant will be offered as an option: SA 5AC.

Corresponding to the traffic situation, the high beam assistant switches the vehicle's high beam headlight on and off, thus relieving the driver of the task of operating the high beam headlight. High beam can still be switched on and off manually as usual.

Note: The high beam assistant is an assistance function so that the driver always has the option and duty to override the system when the road situation so requires.

Only the high beam of the xenon headlight is controlled on vehicles equipped with the high beam assistant. The halogen high beam headlights are switched on only with the headlight flasher.

The system consists of an image sensor (special camera for detecting light sources in road traffic) and an FLA control unit. High beam and low beam are still switched by the lights module. The lights module determines whether high beam can be switched on based on a range of various input variables.



Index	Explanation
1	Image Sensor
2	LVDS interface
3	FLA Control Unit

The image sensor is located behind the base of the interior rear-view mirror. The FLA control unit is installed directly on the back of the mirror glass in the interior rear-view mirror.

During operation, the image sensor registers points of light that are subsequently evaluated in the FLA control unit. The image sensor can distinguish between various parameters such as light color and light intensity.

When it determines reasons for deactivating high beam, the FLA control unit sends a deactivation recommendation to the lights module. Otherwise an activation recommendation is sent.

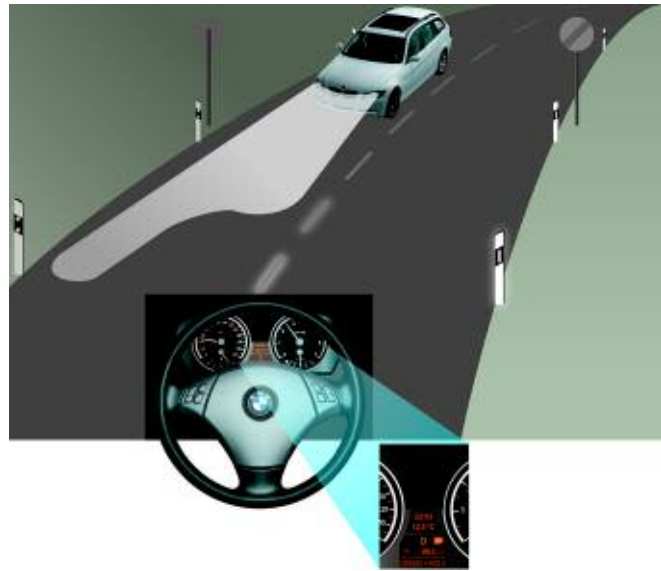
The high beam is switched off in following situations:

- Oncoming/Preceding traffic
- Street lamps (e.g. urban areas, ...)
- Ambient brightness too high (e.g. twilight, ...)
- Driving speed too low

Oncoming Traffic

In connection with oncoming traffic, the high beam assistant must be able to distinguish between reflective traffic signs, other light sources and the headlights of oncoming vehicles.

The detection range is approximately 1000 meters.



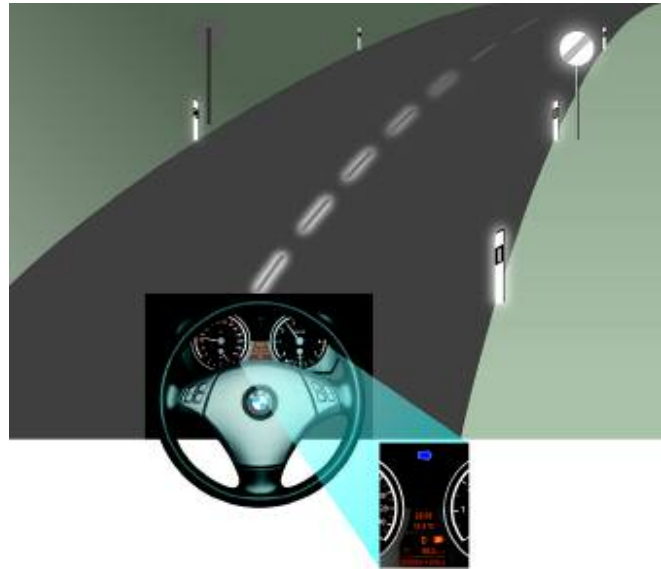
Preceding Traffic

Although the tail lights of preceding vehicles are often illuminated relatively weakly compared to other light sources, the FLA must still be able to reliably detect a vehicle at a distance of approximately 400 meters.



Various Lighting Situations

The FLA sends a switch-on recommendation to the lights module also in response to many non-specific light sources (traffic signs, road markings, lane demarcation elements, etc.) in the detection range of the high beam assistant. High beam is switched on and the high beam assistant indicator lamp is activated.

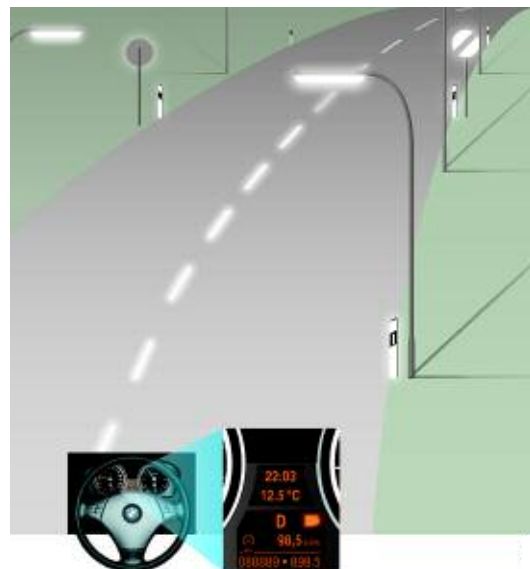


Adequate Light Levels

The high beam assistant sends a switch-off recommendation to the lights module when the vehicle is in surroundings with adequate light and lighting levels.

Such conditions may be:

- Daylight
- Twilight
- Illuminated places
- Street lights



System Limits

Under certain conditions, the high beam assistant may send deactivation or activation recommendations to the lights module that may not appear logical to the driver.

The system can reach its functional limits in following situations:

- Extremely unfavorable weather conditions (e.g. fog)
- Poorly illuminated road users (e.g. riders on small motorcycles, cyclists, pedestrians)
- Individual driving situations (e.g. sharp bends, steep brows and hollows of hills, traffic coming at right angles from left or right)

Traffic Signs

Due to their appearance and height, certain traffic signs are very difficult to distinguish from headlights. Particularly traffic signs indicating a sharp bend cannot always be interpreted correctly by the high beam assistant.



Under certain circumstances, the high beam assistant may interpret the reflective red areas in this example as tail lights.

Bends and Brow of Hills

In dark conditions, the driver recognizes oncoming vehicles at a distance even before bends and brows of hills.

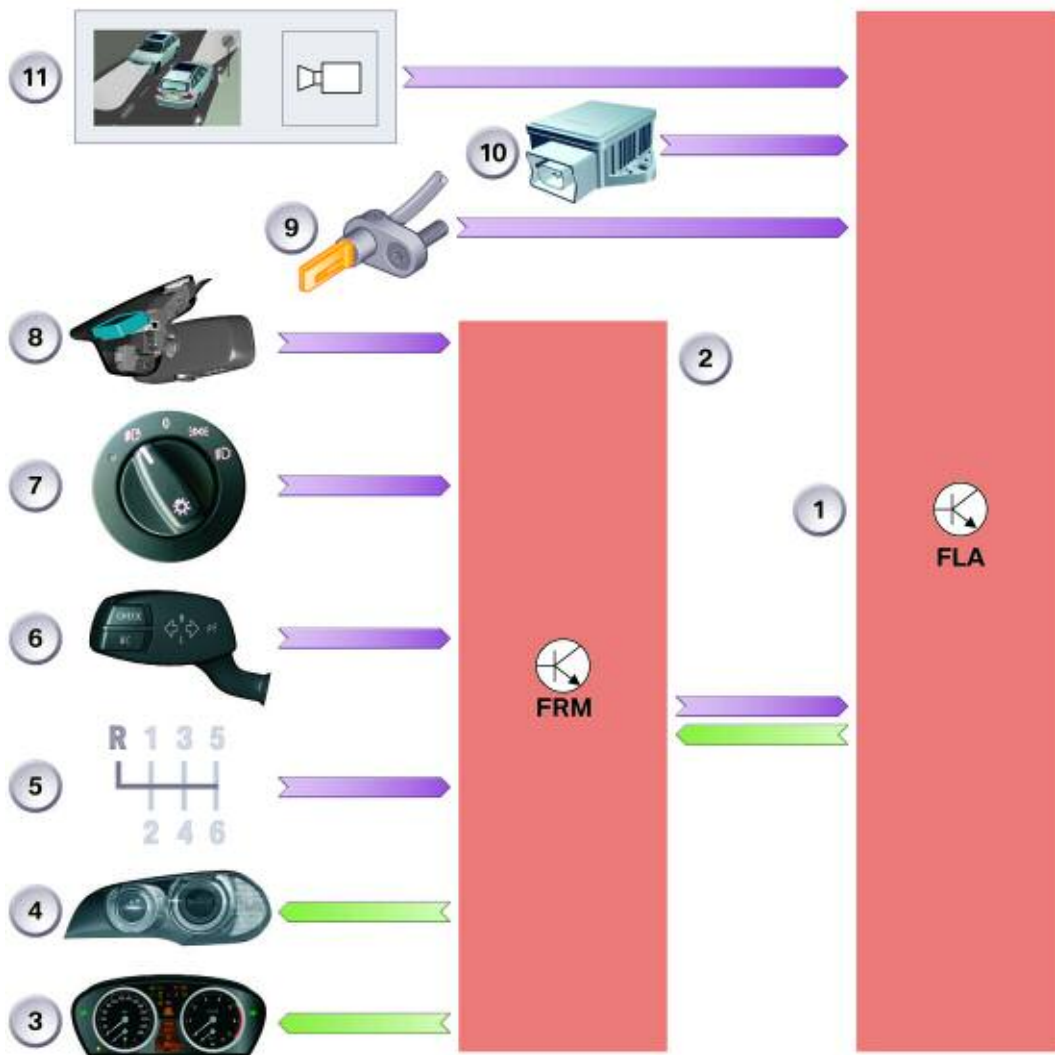
The light beam of an oncoming vehicle is already visible before the headlights can be made out. The high beam assistant, on the other hand, can only recognize an oncoming vehicle when the headlights can actually be detected as light sources.

A bright light on the horizon does not result in the high beam assistant sending a switch-off recommendation.



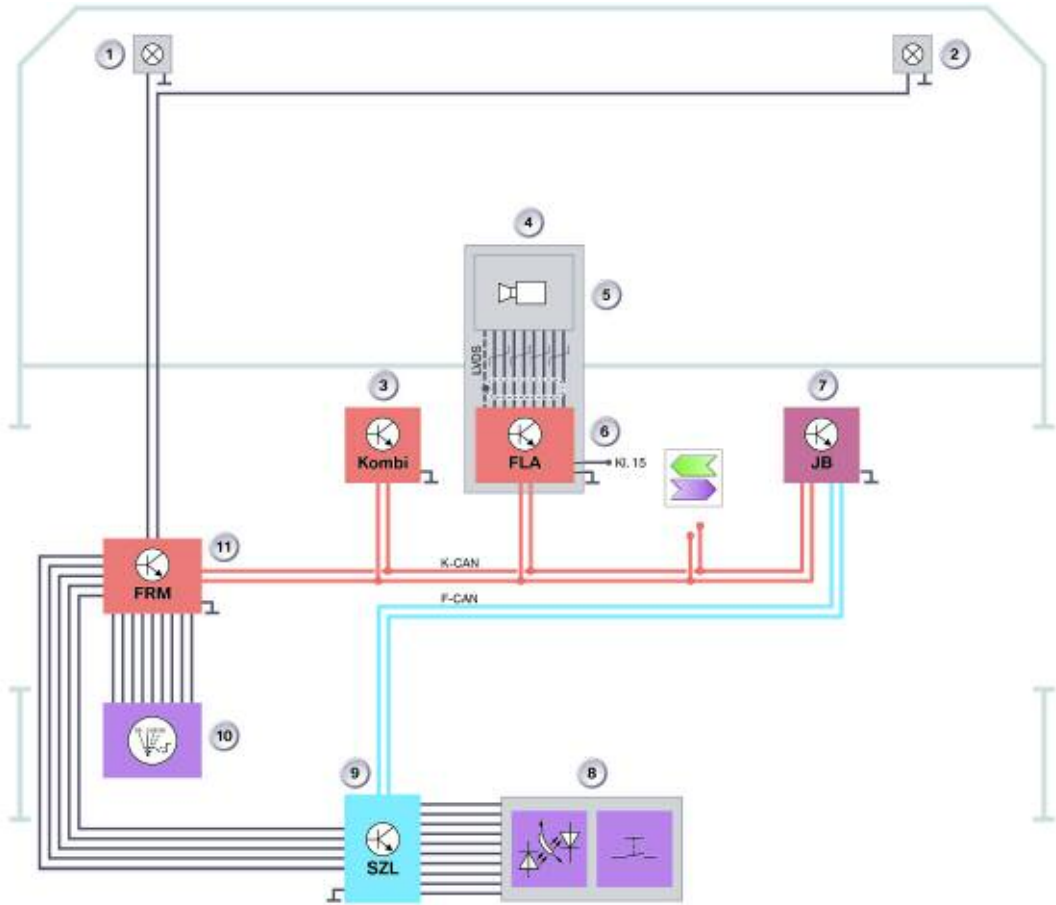
System Overview

Input/Output - High Beam Assistant



Index	Explanation	Index	Explanation
1	FLA Control Unit	7	Light Switch
2	Footwell Module	8	Rain/Light/Solar Sensor
3	Instrument Cluster	9	Wheel Speed Sensor
4	Headlight	10	DSC Sensor
5	Reverse Gear Switch	11	Image Sensor
6	Direction Indicator/High Beam Switch		

System Circuit Schematic - High Beam Assistant



Index	Explanation	Index	Explanation
1	High Beam Headlight, Left	8	Steering Column Stalk, High Beam Headlight
2	High Beam Headlight, Right	9	Steering Column Switch Cluster
3	Instrument Cluster	10	Light Switch
4	Housing of Interior Rear-view Mirror	11	Footwell Module
5	Camera for High Beam Assistant	K-CAN	Body CAN
6	High Beam Assistant Control Unit	PT_CAN	Powertrain CAN
7	Junction Box Control Unit		

K-CAN Signals at Control Unit of Footwell Module			
In/Out	Signal	Source	Function
In	Position "A" (Automatic) on light switch	> Light switch > Footwell module	High beam assistance possible only in Automatic position
In	High beam/low beam	> Steering column stalk, high beam > Footwell module	Activation of high beam assistant system
In	Reverse gear	> EGS	Deactivation of high beam assistant
In	Brightness level of ambient light	> Rain/light/solar sensor >Roof function Center	Precondition: activation of high beam headlight
Out	High beam headlight on/off	> High beam	High beam switched on and off by footwell module
Out	Indicator lamp	> Instrument cluster	Activation of indicator lamp for high beam assistant

K-CAN Signals at Control Unit for High Beam Assistant			
In/Out	Signal	Source	Function
In	Road Speed	> Wheel speed sensors > DSC	Deactivation of high beam assistant below certain speed
In	Yaw Rate	> DSC Sensor > DSC	Adaptation of detection range when cornering
In	Bulb Condition	> Footwell Module	Monitoring condition of high beam on/off
Out	Switch-on and switch-off recommendation	> Footwell Module	Switch-on and switch-off recommendation to footwell module - footwell module decides whether system is switched on or off

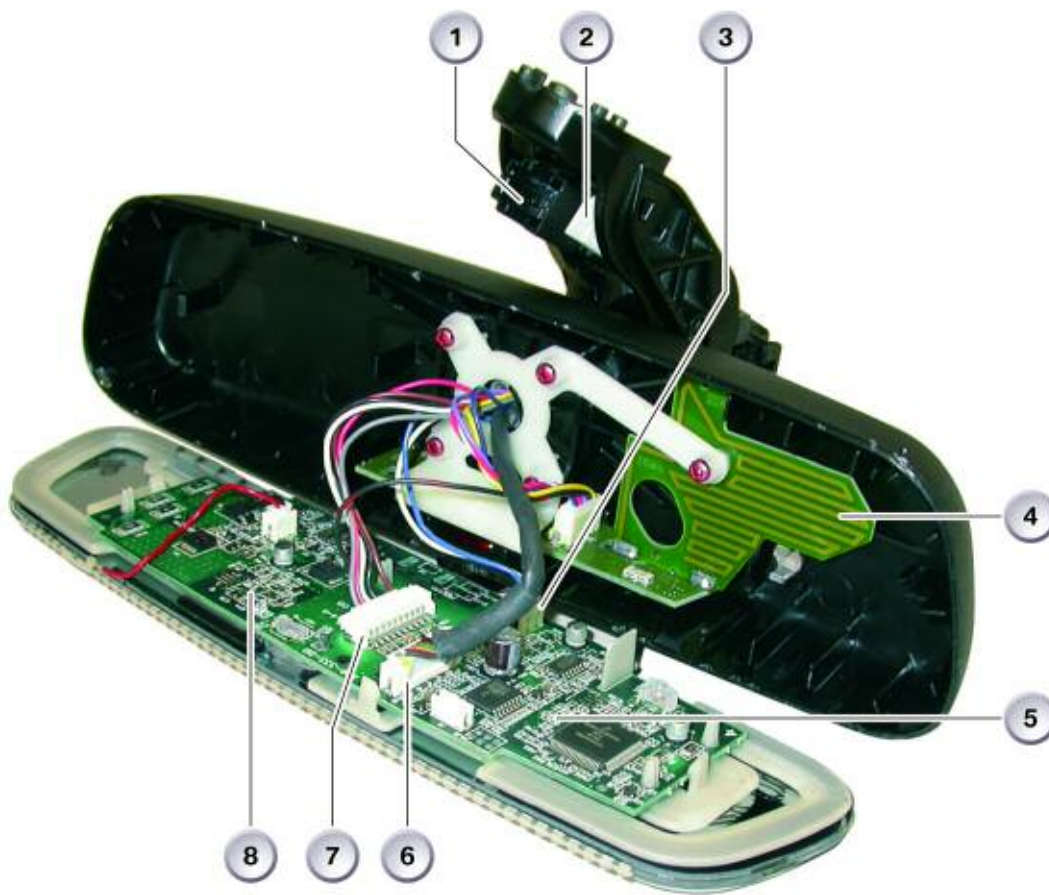
System Components

High Beam Assistant Control Unit

Design of Interior Rear-view Mirror

The entire hardware of the high beam assistant is installed in the interior rear-view mirror. The hardware consists of an image sensor mounted in the mirror base as well as electronic evaluator circuitry in the interior rear-view mirror. A special mirror base, on which the image sensor is mounted, is required for the high beam assistant.

The high beam assistant also consists of a cover for the image sensor and the sensors already installed (rain/driving lights sensor and condensation sensor).



Index	Explanation	Index	Explanation
1	10-pin connector	5	FLA control unit
2	3-pin connector	6	LVDS interface
3	K-CAN connector	7	Connector for mirror electronics
4	Antenna for Remote Control (E64)	8	Electronic evaluator for electrochromic mirror

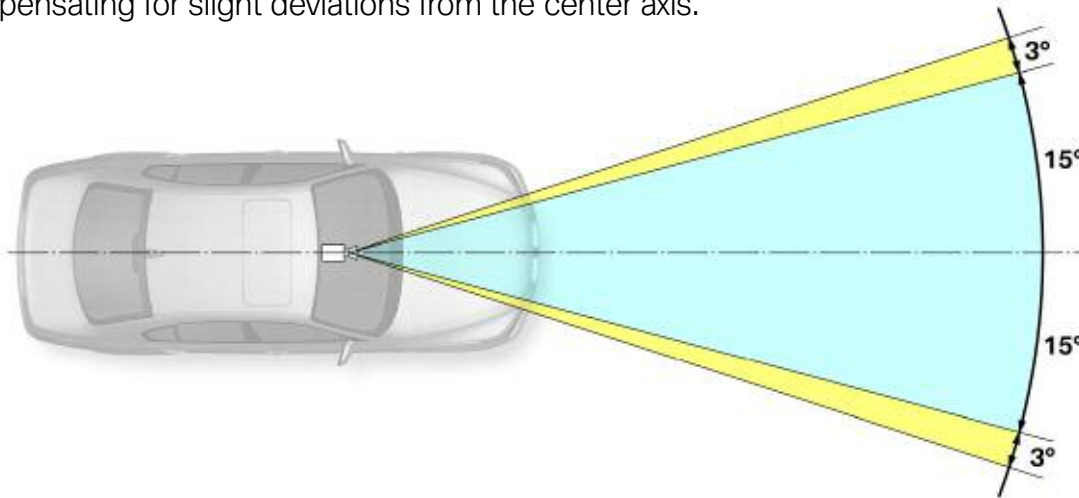
Image Sensor

The image sensor below the screen print (black area at upper edge of the windscreen) points forward through the windscreen. The sensor field is 15° to the left and right (see graphic) as well as 5° to the top and bottom.

The center axis of the image sensor must be aligned parallel to the longitudinal axis of the vehicle to ensure the same degree of functional accuracy for each type of vehicle.

Otherwise, restrictions in the sensor field may result in impaired detection of vehicles in bends and less effective differentiation between vehicles and reflections from road signs.

The high beam assistant adapts itself within a tolerance of 3° , thus automatically compensating for slight deviations from the center axis.



■ Mounting and Connection

Connection to the system network is provided by the existing 10-pin connector and an additional 3-pin connector. Both connectors are located in the base of the interior rear-view mirror and are secured with a connector holder. The pin assignments of the two connectors are listed in the section "Service information".

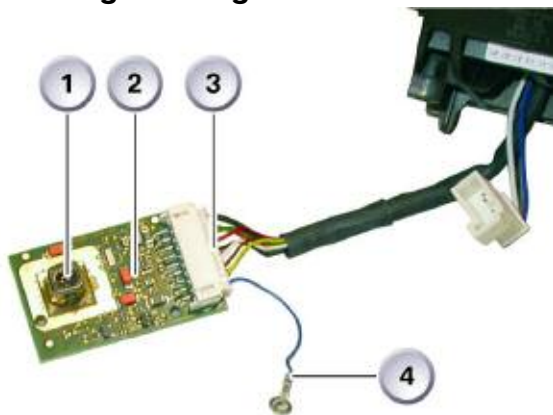
The FLA is firmly connected to the vehicle windscreen by means of the mirror base.

Without corresponding adaptation in vertical direction, the field of vision of the high beam assistant would vary upward or downward depending on the angle of inclination of the windscreen.

To compensate for this deviation, different mounting brackets are used corresponding to the type of vehicle.

The 3-pin connector features a mechanical coding facility which ensures the matching bracket is always used corresponding to the type of vehicle.

■ Design of Image Sensor



Index	Explanation
1	Image sensor
2	PC-board for image sensor
3	LVDS connector
4	Ground connection

Principles of Operation

The functions of the high beam assistant (FLA) relevant to the driver are automatic activation of the high beam and low beam settings. For this purpose, the high beam assistant sends a recommendation to switch on or switch off high beam via the K-CAN bus to the lights module.

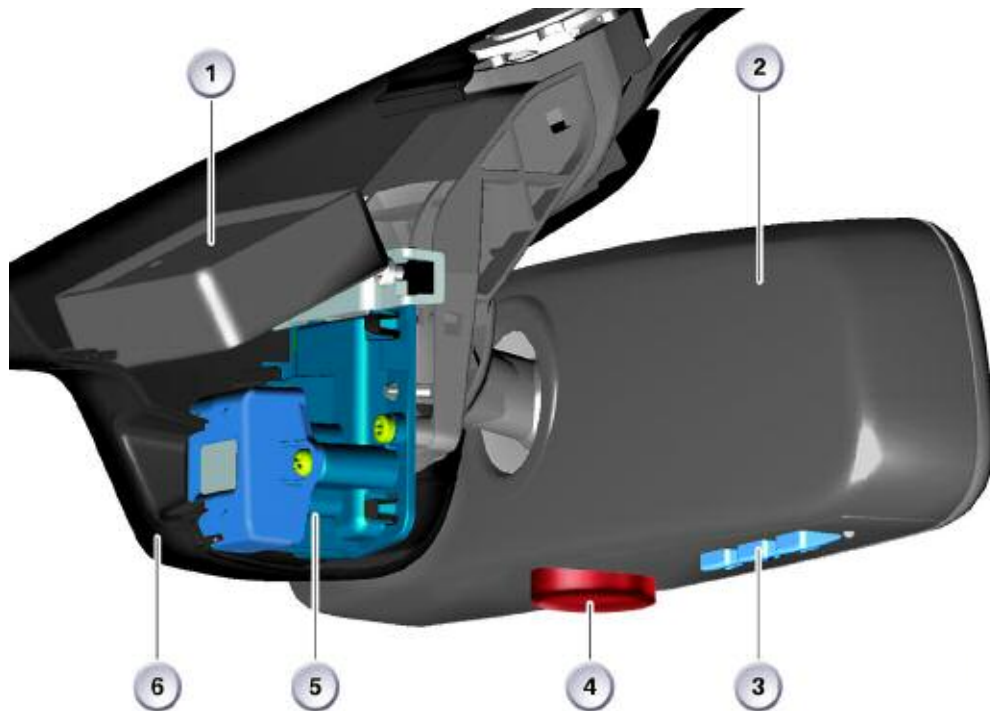
This recommendation is always sent (also during daytime driving) at terminal 15 ON. The lights module evaluates the switch-on or switch-off recommendation only if the system has been activated by the driver.

The high beam assistant always switches off high beam before another road user is dazzled. High beam must therefore be switched off at the latest when another road user comes into the range of the light beam of the high beam headlights.

Operation of the high beam assistant is based on an image sensor with image-processing software algorithms.

Light components are registered by a red/white-sensitive image sensor and transferred to the FLA control unit.

The image sensor is located at the base of the interior rear-view mirror with the FLA control unit housed in the mirror.



Index	Explanation	Index	Explanation
1	RLS sensor	4	Indicator for anti-theft alarm system
2	FLA control unit in interior rear-view mirror	5	Image sensor
3	Buttons for UGDO	6	Cover

Electronic Evaluator

The image sensor transmits the image via a LVDS data link to the microcontroller of the FLA control unit where it is stored in a buffer ready for evaluation.

In addition to the light signals of the image sensor, the electronic evaluator also evaluates the vehicle speed.

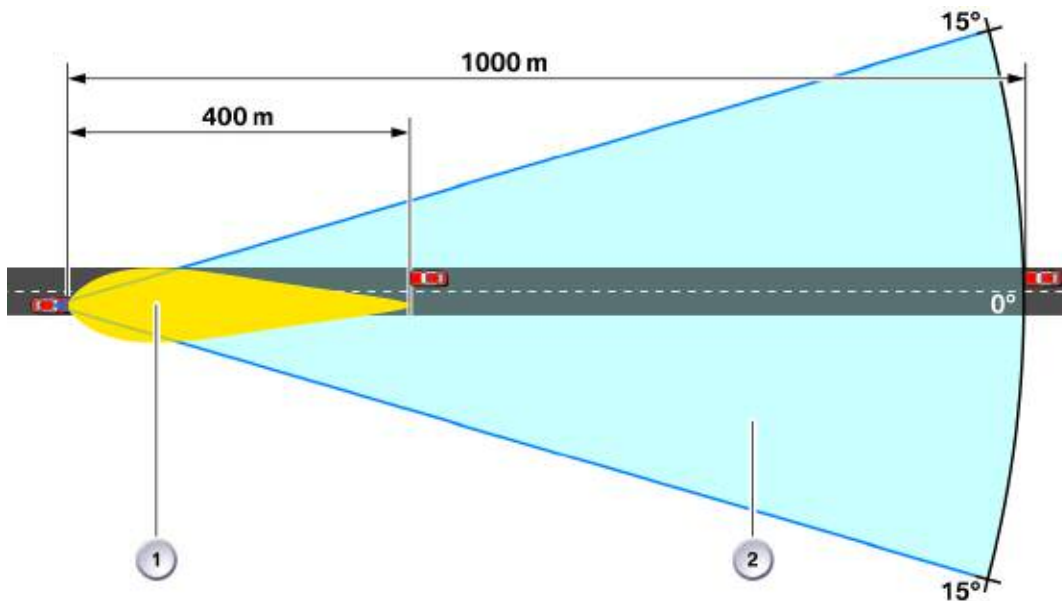
When the speed drops below 38 km/h, the high beam assistant sends a switch-off recommendation to the lights module and dips the high beam headlights. The switch-off recommendation is sent irrespective of other conditions.

As from a speed of more than 50 km/h, high beam is switched on again as soon as the situation so permits.

Detection of Oncoming and Preceding Traffic

The high beam assistant must detect oncoming traffic as soon as possible and dip the high beam headlights. The high beam must be dipped at the latest when the oncoming traffic enters the range of the high beam light beam (see graphic). This corresponds to a distance of approximately 400 m.

The detection range of the image sensor is approximately 1000 m.



Index	Explanation
1	High beam light
2	Detection range of image sensor

Detection of Street Lamps and Adequate General Light Levels

According to European legislation, high beam is to be switched off in urban and non-urban areas that are sufficiently illuminated. There is therefore no regulation requiring high beam to be switched off in unlit localities. Two methods are necessary to detect sufficiently lit areas (urban areas are normally lit).

- Recognition of street lamps
- Recognition of adequate general light levels

■ Recognition of Street Lamps

The detection of street lamps is necessary to ensure rapid reaction of the system. Many street lamps indicate a built-up area or a sufficiently lit road. A deactivation recommendation is sent when the high beam assistant detects several street lamps in short succession.

■ Recognition of Adequate General Light Levels

At night, street lamps, billboards, housing lighting etc. generate relatively high general light levels within built up areas. The driver will normally not require high beam to be switched on in such areas.

These different general light levels between urban and non-urban areas are registered by the image sensor and included in the evaluation process. High beam is switched off as from a certain general light level. The high beam deactivation recommendation is therefore always sent during daytime driving.

Covered Sensor Field

The image sensor is mounted on the mirror retaining fixture such that it covers a range of 5° up and down. The housing of the image sensor is designed such that it adapts to the corresponding windscreen of the vehicle.

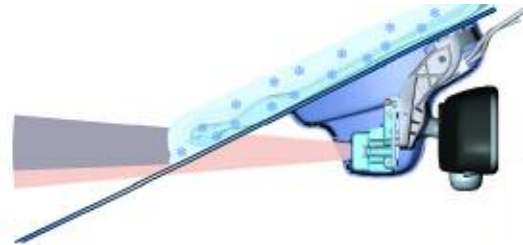


The high beam assistant recognizes when the sensor field is covered, e.g. by a sticker on the windscreen, soiled lens, snow on windscreen etc. due to the absence of light from the headlight in the lower area of the image.

The check control message "Sensor field covered" warns the driver when the sensor field is covered.

The sensor field of the image sensor must be covered for at least 16 seconds at a minimum speed of 5 km/h in order for a check control message to be sent.

The high beam assistant cannot detect when only the upper area of the image is covered. A partially covered image sensor, however, can affect operation of the high beam assistant: the high beam assistant no longer detects light sources to their full extent.



Misinterpretation of the surroundings can result in incorrect switch-on or switch-off recommendations.

Indications and Operation

An additional symbol in the instrument cluster signals the active status:

- Symbol ON = FLA active
- Symbol OFF = FLA inactive

Operation of the blue high beam indicator lamp remains unaffected. This lamp operates as normal in the instrument cluster.



Operating Concept

The high beam assistant (FLA) is active only under following preconditions:

- Light switch set to automatic
- Driving light activated by rain/driving lights sensor
- Direction indicator/high beam switch flicked once in high beam direction

The rules for automatically switching the high beam headlights on and off are stored in the light module. The high beam assistant is designed as an "assistance function" so that the driver always has the option and duty to override the system when the road situation so requires.

The graphic on the following page shows the operation and function of the high beam assistant based on three scenarios.

■ Scenario 1:

The driver has activated the high beam assistant. Low beam is active because the traffic situation does not permit high beam.

The headlight flasher is operated when the direction indicator/high beam switch is pulled in low beam direction (halogen headlights).

■ Scenario 2:

Irrespective of whether low beam or high beam is activated by the light module, the high beam assistant is deactivated when the direction indicator/high beam switch is pressed in high beam direction.

■ Scenario 3:

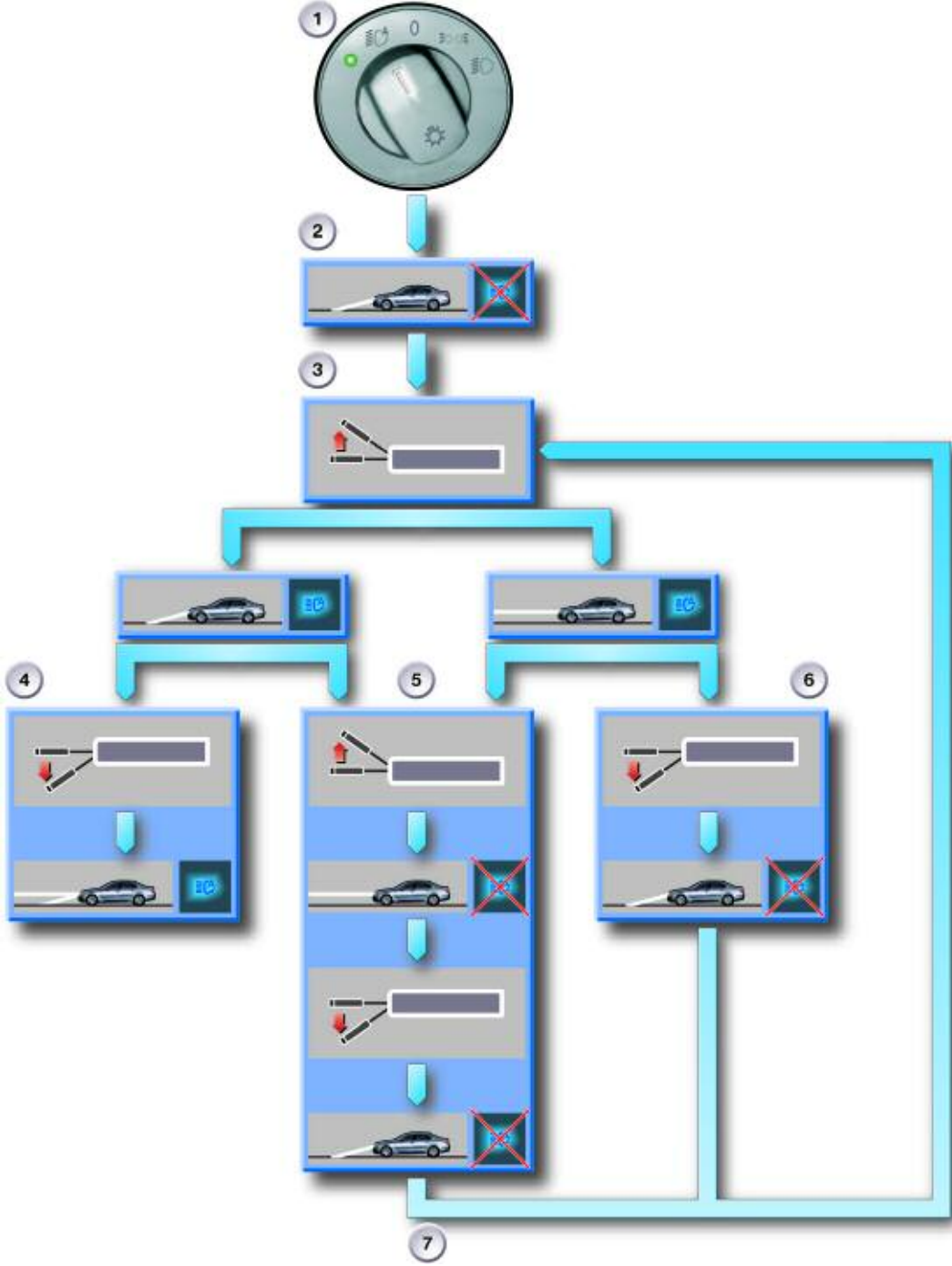
The automatic high beam is deactivated when the driver flicks the direction indicator/high beam switch in low beam direction while high beam is switched on.

■ Reactivating:

The high beam assistant is active again as soon as high beam is switched on after these situations.

Index	Explanation
1	Light switch set to automatic
2	The high beam is active at a corresponding level of darkness
3	The high beam assistant is activated as soon as the direction indicator/high beam switch is pressed forward
4	Scenario 1
5	Scenario 2
6	Scenario 3
7	Cycle is repeated as from number 3

Operating Concept Flow Chart



	high beam		low beam		low beam & flash to pass
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Service Information

Check Control Indicator

The check control indicator can show three different statuses.

Image Sensor Range

The range of the image sensor and the incline of the windscreen result in a field of vision on the windscreen (light area) that must always remain clear.

The high beam assistant may be adversely affected if this area is covered by, for example, stickers, snow and damage (cracks or large-scale stone impact).

Encoding/programming

The FLA can be adapted to various types of vehicle and national requirements by means of the coding data in the EEPROM.

The high beam and low beam characteristics of the automatic function can also be influenced by way of encoding. The system is encoded and programmed via the OBD interface in the vehicle and this procedure must be performed after a replacement.

Possible Customer Perceptions

If customer complaints are received, corresponding inquiries should be made with the customer before performing any repairs or diagnosis.

The following customer statements are possible:

"High beam is not deactivated when... "

Customer statement:

"The high beam assistant does not switch off high beam in built-up areas."

Possible cause:

The light levels in the area are too low. High beam remains switched on.

Customer statement:

"The high beam is not dipped in good time when driving over mountain passes."

Possible cause:

The high beam assistant detects other road users too late or not at all in sharp bends.

Customer statement:

"High beam is not dipped in response to an oncoming motor scooter."

Possible cause:

The high beam assistant does not detect poorly lit vehicles. The high beam assistant also does not detect pedestrians or animals on the road.

Customer statement:

"High beam is not dipped in time when oncoming traffic approaches over the brow of a hill."

Possible cause:

The high beam assistant does not detect higher light levels at the horizon. The high beam assistant does not respond with a switch-off recommendation before the actual headlights of the oncoming traffic are visible.

Customer statement:

"High beam is not dipped when a vehicle comes out of a side street."

Possible cause:

The high beam assistant does not detect vehicles at right angles to the own vehicle.

"High beam is not activated when... "

Customer statement:

"High beam is not switched on while driving slowly."

Possible cause:

The high beam assistant sends a switch-on recommendation to the lights module as from a driving speed of approximately 50 km/h.

Customer statement:

"High beam is switched off in bends."

Possible cause:

In tight bends it is possible that the vehicle speed drops below the speed threshold or there are considerable reflections from traffic signs, causing high beam to switch off.

Customer statement:

"High beam is switched off for no apparent reason."

Possible cause:

Highly reflective traffic signs or reflectors of other road users (e.g. trailer parked on side of road).

Other Customer Statements:

Customer statement:

"The halogen bulbs for high beam are no longer operable."

Possible cause:

The auxiliary headlights with the halogen bulbs are switched on only as headlight flashers in connection with the high beam assistant. On vehicles equipped with the high beam assistant, the high beam is switched on only with the bi-xenon headlights.